Active Learning Classroom Research Profile

BIOL 401: Advanced Cell Biology
Instructor: Dr. Alison Crowe

● 63 undergraduate students enrolled, mostly Juniors and Seniors
● Class met twice a week for 1 hour 20 minutes in ALC 141

Active Learning in Advanced Cell Biology

Before the Advanced Cell Biology class begins, students sit in small groups and friendly conversation and chatter is heard throughout the classroom. Crowe welcomes the class promptly at the start of class and outlines the tasks and goals for the day. On this particular day, Crowe describes the Immediate Feedback Assessment Technique (IF-AT) quiz students will take. The IF-AT quiz uses a multiple choice format and requires students to scratch off their selected answer on a card, much like a lottery ticket. An asterisk on the card provides immediate feedback about whether their selection was correct, leading students to potentially scratch a second or third choice until they identify the correct answer. Students may earn fewer points on the question with each attempt. The goal is to promote group discussion and give students practice defending their answers with logical arguments.

Crowe gives students 5 minutes to complete the quiz silently on their own. In their ALC table groups, students then have 10 minutes to complete the same quiz in a group, discussing the answer before making their choice on the card and getting immediate feedback. Once the group work begins, there’s a buzz of conversation, laughter, and exclamations -- “Correct! Woo hoo!” and “Yay!” or “Incorrect” and “Ohhhh... oops!” Crowe and her TA roam the room, listening as groups share their IF-AT answers and responding to questions raised in the process. Students then submit their answers with their names and ALC group table number.

Crowe then brings the whole class together to discuss the concepts addressed in the quiz. Students use the table mics to ensure their contributions are heard across the room. Certain quiz answers proved more confusing than others, so Crowe and the class discuss a particularly challenging question at length and only move on once general student understanding is confirmed.

For the next activity, Crowe uses the document camera to project a cellular model on cell differentiation from one of the course readings to each of the table monitors. As she describes the model, she also draws on it in real time, circling processes or data of interest. The class joins in a discussion of the model, questioning the model’s assumptions and data. Crowe then provides a short lecture on epigenetic regulation of gene expression, and sets up the class for the next activity. Students are to work in small groups (3-5 students) at their table to answer questions about data pulled from a primary...
scientific article. Crowe tells students “from your introductory Biology courses on up, you have been learning about these concepts,” encouraging them to draw on prior knowledge for the activity.

Again, Crowe and her TA circulate among tables as students work. Crowe uses affirming language in response to student questions--“Yes, that’s right,” “Yes, exactly!” At times she uses questions to encourage students -- “You’re right--but where’s the evidence?” “Good -- are you comfortable interpreting this data on your own?” The student groups become more engaged and engrossed in the activity as it progresses. When a question or point of confusion arises, Crowe often returns to the model via the document camera, referencing particular data or drawing on the model to further illustrate a point.

Crowe closes the activity by calling the class together for a whole-class discussion on any remaining questions or comments on how to interpret the data. Fifteen minutes before class ends, Crowe provides students with a final prompt to work on in their groups, preparation for the molecular models of gene activation during cell differentiation that they will draw the next time they meet. Students focus intently on their work in their groups. Just before class ends, Crowe reviews the learning goals addressed in the day’s activities and provides instructions for upcoming assignments. Students continue working in their groups right up till the end of class -- a productive and engaging class session is complete.

**Pedagogical Goals and Challenges**

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<th>Teaching &amp; Learning Goals</th>
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<td>● Use and integrate student knowledge to creatively solve problems</td>
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<td>● Enhance critical thinking skills</td>
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<td>● Improve written and visual communication skills</td>
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<td>● Improve data analysis and interpretation skills</td>
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<td>● Facilitate peer learning through group work</td>
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<th>Pedagogical Challenges</th>
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<td>● Structuring student groups in ways that maximize student participation and ensure that all voices are heard</td>
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<td>● Designing learning activities that promote student self-confidence and self-efficacy</td>
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Crowe is an experienced Principal Lecturer in the Biology department and a member of the Biology Education Research Group (BERG). The Biology department has one of the largest undergraduate student populations on campus, and the department is supportive of active learning and inclusive teaching. Crowe had been incorporating active learning and student group work into her courses for many years, honing over time the active learning techniques and group work approaches that are most effective. Dissatisfied with traditional lecture-style classrooms, Crowe requested to teach in the Active Learning Classrooms as soon as they were available.
Equitable and effective student group work was a central pedagogical goal and challenge in Biology 401. Crowe designed group work learning opportunities to promote increased student self-confidence and knowledge that they can solve problems as a group and individually. According to Crowe, group work “teaches students the skills of working in a group. They learn how to build ideas together. They hear other people’s ideas and defend their own ideas, too. Students learn a lot better when they have to actively use information.” Crowe further affirmed the importance of group work, citing BERG research showing that collaborative group work improves learning outcomes for all students. However, cultural differences can impact how much value students place on group work, so it is important to include a broad range of activities in a class.

Crowe experimented with different ways of composing student groups over three quarters of teaching Biology 401 in the ALCs. Overall, having students in groups they self-selected (sometimes with friends) worked the best, with some caveats. Group work was designed for multiple small groups (2-3 students per group), but the design of ALC tables (9 students to a table) was such that smaller groups often coalesced into one large group of 9. This had a negative impact on the goal of equal participation among all group members.

Beyond teaching Biology content, Crowe’s goal was to foster transferrable skills that support student success across Biology assignments, courses, and post-graduation. “We do learn content, but I’m more interested in students learning skills they can apply to various situations. I have students analyze figures without the author’s interpretation -- they gain confidence interpreting figures on their own.” Crowe reported that having students practice written communication and drawing molecular processes in class improved their performance on writing assignments and exams.

Crowe reports that student attendance was much better in the ALC than in traditional lecture classrooms, as students are much more accountable to each other in the ALC. “Accountability is huge in this classroom. Students evaluate each other. Part of their grade is based on how much the group participation happens. In past quarters, attendance in lecture was low. In small discussion sections, attendance was always good, since they were graded on group participation.” Student attendance was also incentivized through a random student numbering system for participation in large class discussion. This approach of “random call” increases both accountability and equity in the classroom but can cause anxiety among some students.

Reflecting on the course, Crowe said she thought she achieved her teaching and learning goals: “overall I was really impressed with the students being able to analyze data, come up with models based on data ... their writing progression was really great.”

**Student Experience**

For Biology 401 students, Crowe’s active learning course was a welcome alternative to traditional science lectures, one they described as much more interactive and engaging. As one student explained,
“This class had a relaxed but productive pace and I felt personally engaged instead of just passively absorbing information in a mass of nameless students.” Students believed the class activities complemented the course material: “I think this type of class is great for reading and discussing complex scientific literature.”

Student comments also reflected an appreciation for the comfort they found in group work. One stated simply, “Students get to know each other better, and learning is done together,” while another was reassured by the way group work helped them understand that when struggling with course material, fellow students were “going through the same thing.”

Best Practices from Biology 401
Crowe achieved a successful active learning environment through a variety of practices:

- Designing problem-based learning scenarios that enable students to frequently practice written and oral communication skills, analysis and modelling skills, and presentation skills -- skills needed to succeed in course exams and in the major.
- Designing group learning activities that required student cooperation and ensure both group and individual student accountability.
- Creating opportunities for students to deepen group collaboration skills, giving them enough time throughout the quarter to practice and improve group work skills.
- Engaging with students frequently by minimizing formal lectures.
- Treating all students with respect.
- Frequently communicating (and repeating) course expectations and learning goals.

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